

What is claimed is:

1. A resource management unit for managing one or a plurality of resources, comprising:

5 a first section that, upon accepting a tentative reservation request designating at least one resource, changes a free time period of said designated resource to a tentatively reserved time period based on said tentative reservation request, said first section storing therein information of a valid time period and a issuer of said tentative reservation request;

10 a storage unit for storing at least one said tentative reservation request in a wait queue disposed corresponding to each designated resource for which another tentative reservation request designating said tentatively reserved time period already exists; and

15 a second section that issues information of said tentatively reserved time period and a corresponding tentative reservation ID in response to said tentative reservation request.

2. The resource management unit according to claim 1, further comprising:

5 a third section that, upon accepting a tentative reservation cancel request designating said tentative reservation ID, cancels said tentative reservation time

period to revive said free time period.

3. The resource management unit according to claim 1, further comprising:

5 a fourth section that, upon receiving a job reservation request designating said tentative reservation ID and a reservation time period, changes
said reservation time period designated by said job reservation request to an actually reserved time period, if said reservation time period designated by said job reservation request is included in said tentatively-
10 reserved time period corresponding to said designated tentative reservation ID and a issuer of said job reservation request matches with said issuer of said tentative reservation request.

4. The resource management unit according to claim 2, further comprising:

5 a fifth section that cancels said tentatively reserved time period for which said validity time period has expired to thereby revive said free time period;

a sixth section that reads out said tentative reservation request stored in said wait queue, said sixth section changing said free time period revived by said fifth section to another tentatively reserved time period

10 based on said read-out tentative reservation request,
said sixth section storing information of an issuer of
said read-out tentative reservation request; and

a seventh section that issues said another
tentatively reserved time period changed by said sixth
15 section and a corresponding tentative reservation ID to
the issuer of said read-out tentative reservation request.

5. A job scheduler communicated with at least
one resource management unit for scheduling a job,
said job controller comprising:

a first member that issues a tentative reservation
5 request designating each resource of a plurality of
resources to be used in a job, to a resource management
unit managing said each resource;

a second member that receives a notification of a
tentatively reserved state of said each resource or
10 storage of said tentative reservation request in a wait
queue in response to said tentative reservation request;

a third member that assigns the job to at least one
first resource, for which said tentatively reserved state
is received and selected from among said plurality of
15 resources, while excluding at least one second resource
among said plurality of resources, to create a job
schedule including an execution time period of each of

said first resource;

20 a fourth member that issues a job reservation request for said first resource, to said resource management unit managing said first resource; and

a fifth member that issues a tentative reservation cancel request for said second resource, to said resource management unit managing said second resource.

6. The job scheduler according to claim 5, further comprising:

5 a sixth member that, after receiving a notification of storage of said tentative reservation request in said wait queue from said resource management unit, controls said third member to create said job schedule either after a designated time interval elapsed since receiving said notification without a further notification, or after receiving another notification that said
10 tentative reservation request is taken out of said wait queue to said tentatively reserved state.

7. A distributed resource management system comprising:

5 at least one said resource management unit according to claim 1; and a job scheduler communicated with said resource management unit, said job scheduler

comprising:

10 a first member that issues a tentative reservation request designating each resource of a plurality of resources to be used in a job, to said resource management unit managing said each resource;

a second member that receives information of a tentatively reserved state of said each resource from said resource management unit;

15 a third member that assigns the job to at least one first resource, for which said tentatively reserved state is received and selected from among said plurality of resources, while excluding at least one second resource among said plurality of resources, to create a job schedule including an execution time period of each of
20 said first resource;

a fourth member that issues a job reservation request for said first resource, to said resource management unit managing said first resource; and

25 a fifth member that issues a tentative reservation cancel request for said second resource, to said resource management unit managing said second resource.

8. A distributed resource management system comprising:

at least one resource management unit that

manages one or a plurality of resources; and

5 at least one job scheduler communicated with said
at least one resource management unit, said job
scheduler having a job reservation function including
issuing a tentative reservation request for a plurality of
resources to be used in a job,

10 said resource management unit comprising:

 a first section that receives two kinds of
reservation requests for tentative reservation and job
reservation, issued by said job scheduler, wherein said
tentative reservation is a combinational operation of
15 acquiring a reservation state of resources and trying to
tentatively reserve resources, and is performed
designating at least one resource managed by said
resource management unit;

 a second section that, if a resource for which
20 said tentative reservation request received from said job
scheduler does not have another tentative reservation
and has a free time period thereof, sets a tentatively
reserved state for said resource and issues information
of said tentatively reserved state including a tentatively
25 reserved time period in response to said tentative
reservation request;

 a third section that stores a validity time period
and information of said job scheduler having issued said

tentative reservation request in connection with said
30 tentatively reserved time period, wherein said job
reservation includes an operation of reserving resources
in advance for execution of a designated job and is
performed via a job reservation request designating at
least one resource that is managed by said resource
35 management unit and a reservation time period of said
resource;

a fourth section that accepts said job reservation
request and changes the reservation time period
specified by said job reservation request to a job
40 reserved state, if the specified time period is included in
a tentatively-reserved time period and the issuer of said
job reservation request matches with the issuer of the
tentative reservation request; and

a fifth section that, when it reaches a start time
45 specified by the job reservation, controls to allocate the
resource for execution of the job and/or, when it reaches
an end time specified by said job reservation, controls to
release allocation of the resource to the job.

9. The distributed resource management system
according to claim 8, wherein said resource
management unit accepts two kinds of cancel requests
including tentative reservation cancel request and a job

- 5 cancel request issued corresponding to said two kinds of reservation requests by said job scheduler.

10. The distributed resource management system according to claim 8, further comprising at least one user terminal communicated with said job scheduler for inputting through said user terminal a job
5 to said job scheduler, wherein said job scheduler comprises a first member that assigns said job input through said user terminal to resources,

said assignment to resources by said job scheduler including at least one of:

- 10 a process of issuing a tentative reservation request to said resource management unit;

a process of creating an execution schedule of the job for resources for which said tentative reservation was successful; and

- 15 a process of issuing a job reservation request according to said execution schedule to said resource management unit.

11. The distributed resource management system according to claim 8, wherein said resource management unit comprises:

a schedule storage unit that stores, for each

5 resource managed by said resource management unit,
information of said job designating said each resource
and the time period for which said each resource is
reserved;

10 a tentative-reservation-request storage unit that
has a wait queue for each resource managed by said
resource management unit, wherein a waiting tentative
reservation request for said resource is stored in said
wait queue;

15 a tentative-reservation-request receiving section
that receives a tentative reservation request from said
job scheduler and stores information of the tentative
reservation in said schedule storage unit or said
tentative-reservation-request storage unit;

20 a job-reservation-request receiving section that
receives a job reservation request from said job
scheduler and stores information of the job reservation
in said schedule storage unit; and

25 a schedule management section that monitors the
information of the job reservation and the tentative
reservation stored in said schedule storage unit and
performs allocation and release of resources, and/or
discard of said tentative reservation according to the
information of said job reservation and said tentative
reservation.

12. The distributed resource management system according to claim 11, wherein said resource management unit comprises:

5 a tentative-reservation-cancel-request receiving section that receives a tentative reservation cancel request from said job scheduler and discards information of a corresponding tentative reservation from said schedule storage unit or said tentative-reservation-request storage unit; and

10 a job-cancel-request receiving section that receives a job reservation cancel request from said job scheduler and discards information of a corresponding job reservation from said schedule storage unit and releases resources allocated to the job.

13. The distributed resource management system according to claim 8, wherein said job scheduler comprises:

5 a waiting-job storage unit that temporarily stores information of a job input through said user terminal;

a schedule storage unit that stores information of a job for which reservation is confirmed for each resource;

a job-execution-request receiving member that

10 receives a job execution request from said user terminal
and stores contents of said job execution request in said
waiting-job storage unit;

15 a job scheduling member that takes out a job
stored in said waiting-job storage unit and assigns the
job to resources, said assignment of the job to resources
including the issuing of a tentative reservation request
to said resource management unit, the creation of a job
execution schedule, and issuing of a job reservation
request to said resource management unit.

14. The distributed resource management
system according to claim 13, wherein said job
scheduler comprises:

5 a job-cancel-request receiving member that, upon
receiving a job cancel request from said user terminal,
discards a waiting job stored in said waiting-job storage
unit or a corresponding job registered in said schedule
storage unit, and issues a job reservation cancel request
to said resource management unit.

15. The distributed resource management
system according to claim 8, wherein said resource
management unit further comprises:

a sixth section that assigns resources managed by

5 said resource management unit for execution of said job according to a job reservation request received from said job scheduler; and

10 a seventh section that, upon receiving a tentative reservation request for already, tentatively reserved resources, stores said tentative reservation request in a wait queue provided for each of the resources, wherein when a tentative reservation is discarded due to a tentative reservation cancel request or the expiration of a validity time period, a tentative reservation request
15 directed to the same resource as the discarded tentative reservation is taken out of the wait queue, and becomes a valid tentative reservation,

an eighth section that, when the tentative reservation request is taken out of said wait queue,
20 issues a notification of said valid tentative reservation to said job scheduler having issued said tentative reservation request,

said job scheduler further comprising:

25 a first member that controls such that, when the tentative reservation request issued by said job scheduler has entered said wait queue, creation of job execution schedule waits until said tentative reservation becomes valid and then starts the creation of an execution schedule thereof.

16. The distributed resource management system according to claim 14, wherein said first member of said job scheduler further controls such that, if the tentative reservation request does not become
5 valid for the tentative reservation request in a predetermined time interval until, the process proceeds to said creation of said job execution schedule while excepting the resource corresponding to the tentative reservation request stored in said wait queue.

17. A method for use in a resource management unit that manages one or a plurality of resources, comprising the steps of:

upon accepting a tentative reservation request
5 designating at least one resource, changing a free time period of said designated resource to a tentatively reserved time period based on said tentative reservation request, and storing a valid time period and a issuer of said tentative reservation request;

10 storing at least one said tentative reservation request in a wait queue disposed corresponding to each designated resource for which another tentative reservation request designating said tentatively reserved time period already exists; and

15 issuing information of said tentatively reserved
time period and a corresponding tentative reservation
ID in response to said tentative reservation request.

18. The method according to claim 17, further
comprising the step of:

 upon accepting a tentative reservation cancel
request designating said tentative reservation ID,
5 canceling said tentative reservation time period to
revive said free time period.

19. The method according to claim 17, further
comprising the step of:

 upon receiving a job reservation request
designating said tentative reservation ID and a
5 reservation time period, changing said reservation time
period designated by said job reservation request to an
actually reserved period, if said reservation time period
designated by said job reservation request is included in
said tentatively-reserved time period corresponding to
10 said designated tentative reservation ID and a issuer of
said job reservation request matches with said issuer of
said tentative reservation request.

20. The method according to claim 17, further

comprising the steps of:

canceling said tentatively reserved time period for
which said validity time period has expired to revive
5 said free time period;

reading out said tentative reservation request
stored in said wait queue,

changing said free time period revived by said
fifth section to another tentatively reserved time period
10 based on said read-out tentative reservation request,

storing information of an issuer of said read-out
tentative reservation request; and

issuing said another tentatively reserved time
period changed by said changing step and a
15 corresponding tentative reservation ID to the issuer of
said read-out tentative reservation request.

21. A method for use in a job scheduler,
communicated with one or a plurality of resource
management units, for scheduling a job, said method
comprising the steps of:

5 issuing at least one tentative reservation request
designating a plurality of said resources to be used in a
job to at least one resource management unit managing
said plurality of said resources;

receiving a notification of a tentatively reserved

10 state of said each resource or storage of said tentative reservation request in a wait queue in response to said tentative reservation request;

assigning the job to at least one first resource, for which said tentatively reserved state is received and
15 selected from among said plurality of resources, while excluding at least one second resource among said plurality of resources, to create a job schedule including an execution time period of each of said first resource;

issuing a job reservation request for said first
20 resource, to said resource management unit managing said first resource; and

issuing a tentative reservation cancel request for said second resource, to said resource management unit managing said second resource.

22. The method according to claim 21, further comprising the step of:

controlling, after receiving a notification of storage of said tentative reservation request in said
5 wait queue from said resource management unit, said third member to create said job schedule either after a designated time interval elapsed since receiving said notification without a further notification, or after receiving another notification that said tentative

10 reservation request is taken out of said wait queue to
said tentatively reserved state.

23. A method for use in a distributed resource
management system including at least one resource
management unit for managing at least one resource
and at least one job scheduler communicated with said
5 resource management unit, having a job reservation
function including issuing a tentative reservation
request for a plurality of resources to be used in a job,
said method comprising the steps of :

receiving two kinds of reservation requests for
10 tentative reservation and job reservation in said
resource management unit, issued by said job scheduler,
wherein said tentative reservation is a combinational
operation of acquiring a reservation state of resources
and trying to tentatively reserve resources, and is
15 performed designating at least one resource managed
by said resource management unit;

setting in said resource management unit a
tentatively reserved state for said resource and issuing
said tentatively reserved state including a tentatively
20 reserved time period in response to said tentative
reservation request, if a resource for which said
tentative reservation request received from said job

scheduler does not have another tentative reservation and has a free time period thereof;

25 storing in said resource management unit a validity time period and information of said job scheduler having issued said tentative reservation request in connection with said tentatively reserved time period, wherein said job reservation includes an
30 operation of reserving resources in advance for execution of a designated job and is performed via a job reservation request designating at least one resource that is managed by said resource management unit and a reservation time period of said resource;

35 accepting by said resource management unit said job reservation request and changing the time period designated by said job reservation request to a job-reserved state, if the designated time period is included in a tentatively-reserved time period and the issuer of
40 said job reservation request matches with the issuer of the tentative reservation request; and

 controlling to allocate the resource for execution of the job, when it reaches a start time designated by the job reservation, and/or to release allocation of the
45 resource to the job, when it reaches an end time designated by said job reservation.

24. The method according to claim 23, wherein said resource management unit accepts two kinds of cancel requests including a tentative reservation cancel request and a job cancel request issued corresponding to said two kinds of reservation requests by said job scheduler.

25. The method according to claim 23, further comprising the step of assigning a job to resources in said job scheduler, said job being input from a user terminal to said job scheduler, said assigning step comprising the steps of:

issuing a tentative reservation request to said resource management unit;

creating an execution schedule of the job for resources for which said tentative reservation was successful; and

issuing a job reservation request according to said execution schedule to said resource management unit.

26. The method according to claim 23, further comprising, upon receiving said tentative reservation request in said resource management unit, the steps of:

storing information of a corresponding tentative reservation in a schedule storage unit or in a wait

queue provided in said resource management unit for each of said resources;

upon receiving said job reservation request in said resource management unit, storing information of a
10 corresponding job reservation in said schedule storage unit; and

monitoring the information of said job reservation and said tentative reservation, to perform allocation and release of resources, and/or discard said tentative
15 reservation based on the information of said job reservation and said tentative reservation.

27. The method according to claim 23, further comprising the steps of:

receiving a tentative reservation cancel request in said resource management unit from said job scheduler
5 to discard information of a corresponding tentative reservation from said schedule storage unit or said wait queue; and

receiving a job reservation cancel request from said job scheduler to discard information of a
10 corresponding job reservation from said schedule storage unit and release resources allocated to the job.

28. The method according to claim 23, further

comprising the steps of:

receiving a job execution request from said user terminal to store contents of a corresponding job in said job scheduler; and

creating a job schedule corresponding to said job execution request in said job scheduler, wherein said assignment of the job to resources including the issuing of a tentative reservation request to said resource management unit, the creation of a job execution schedule, and the issuing of a job reservation request to said resource management unit.

29. The method according to claim 28, further comprising, upon receiving a job cancel request from said user terminal in said job scheduler, the steps of:

upon receiving a job cancel request from said user terminal, discarding in said job scheduler a waiting job stored in a waiting job storage unit or a corresponding job registered in said schedule storage unit; and

issuing a job reservation cancel request from said job scheduler to said resource management unit.

30. The method according to claim 23, further comprising the steps of:

allocating resources managed by said resource

management unit to execution of said job according to a
5 job reservation request received from said job scheduler;

upon receiving a tentative reservation request for
already, tentatively reserved resources, storing said
tentative reservation request in a wait queue provided
for each of the resources, wherein when a tentative
10 reservation is discarded due to a tentative reservation
cancel request or the expiration of a validity time period,
a tentative reservation request directed to the same
resource as the discarded tentative reservation is taken
out of the wait queue, and becomes a valid tentative
15 reservation,

upon the tentative reservation request being
taken out of said wait queue, issuing a notification of
said valid tentative reservation from said resource
management unit to said job scheduler having issued
20 said tentative reservation request;

controlling in said job scheduler such that, when
the tentative reservation request issued by said job
scheduler has entered said wait queue, creation of job
execution schedule waits until said tentative
25 reservation becomes valid and then starts the creation
of an execution schedule thereof.

31. The method according to claim 30, further

comprising the step of: at the end of the predetermined time period, ignoring the tentative reservation request stored in said wait queue and proceeding to the creation
5 of an execution schedule, if the tentative reservation request does not become valid in a predetermined time period.

32. A distributed resource management system comprising:

a resource management unit for managing at least one resource;

5 a job scheduler communicated with said resource management unit to schedule a job to use said resources; and

a user terminal communicated with said job scheduler for consecutively issuing a tentative
10 reservation request and a job reservation request for each said resource to said resource management unit;

said resource management unit comprising:

a first section that receives said tentative reservation request from said job scheduler to set a
15 resource designated by said tentative reservation request in a tentatively reserved state; and a second section that, when a tentative reservation request is issued for an already, tentatively reserved resource,

stores the tentative reservation request in a wait queue,
20 wherein said user terminal requests said job scheduler
to execute a job, and wherein said job scheduler
comprises a first member that, after issuing a tentative
reservation request to said resource management unit,
determines resources to which the job is assigned and
25 issues a job reservation request to said resource
management unit to reserve the resources necessary for
execution of the job.

33. A distributed resource management method
for a distributed resource system including at least one
resource management unit that manages one or a
plurality of resources; at least one job scheduler
5 communicated with said at least one resource
management unit and schedules a job to use said
resources; and at least one user terminal communicated
with said job scheduler, said method comprising the
steps of:

10 consecutively issuing a tentative reservation
request and a job reservation request from said job
scheduler for each said resource to said resource
management unit;

after a tentative reservation request is issued for
15 an already, tentatively reserved resource from said job

scheduler, storing said tentative reservation request in a wait queue of said resource management unit; and

after issuing a tentative reservation request to said resource management unit for each said resource,
20 said job scheduler determining resources to which the job is assigned and issuing a job reservation request to said resource management unit to reserve the resources necessary for execution of the job.

34. A program for running on a computer constituting a resource management unit, which manages one or a plurality of resources, said program defining the steps of:

5 upon accepting a tentative reservation request designating at least one resource, changing at least one free time period of said resource to a tentatively reserved time period, and storing information of a validity time period and the issuer of said tentative
10 reservation request in a storage unit;

storing said tentative reservation request in a wait queue for one of said at least one resource that already has a tentatively-reserved time period; and

issuing information of said tentatively reserved
15 time period and tentative reservation ID in response to said tentative reservation request.

35. The program according to claim 34, further defining the step of:

upon accepting a tentative reservation cancel request designating said tentative reservation ID,
5 canceling a tentative reservation corresponding to said tentative reservation ID to cancel said tentatively reserved time period to revive said free time period.

36. The program according to claim 34, further defining the steps of:

upon receiving a job reservation request designating said tentative reservation ID and a request
5 time period, changing said request time period designated by said job reservation request to a job-reserved time period, if said request time period is included in said tentatively-reserved time period corresponding to said tentative reservation ID and the
10 issuer of said job reservation request matches with the issuer of said tentative reservation request.

37. The program according to claim 34, further defining the steps of:

canceling said tentatively-reserved time period for which said validity time period has expired to revive

5 said free time period;

 taking a tentative reservation request out of said
wait queue, changing said revived free time period to
another tentatively reserved time period based on said
taken out tentative reservation request, and storing
10 information identifying the issuer of said taken out
tentative reservation request in the storage unit; and

 issuing a notification of said another tentatively
reserved time period and a tentative reservation ID
corresponding to said another tentatively reserved time
15 period to the issuer thereof.

38. A program for running on a computer
constituting a job scheduler, that is communicated with
a resource management unit, which manages one or a
plurality of resources, said program defining the steps
5 of:

 issuing a tentative reservation request for each of
resources to be used by a job to said resource
management unit managing the resource;

 selecting resources to which said job is assigned
10 from among resources that are tentatively reserved by
said resource management unit and determining a time
period for execution;

 issuing a job reservation request for each of the

resources determined by said selecting step to said
15 resource management unit managing said selected
resource; and

issuing a tentative reservation cancel request for
at least one of the resources tentatively reserved by said
tentative reservation request issuing step to said
20 resource management unit managing the resource.

39. The program according to claim 38, further
defining the steps of:

upon storing said tentative reservation request in
a wait queue of said resource management unit, said
5 job scheduler controlling to proceed to said selecting
step after a predetermined time period has elapsed or a
notification of said tentative reservation request having
been taken out of said wait queue has arrived.